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ABRomics: A Galaxy-based one health antimicrobial resistance platform

Pierre Marin, Bérénice Batut, Kenzo-Hugo Hillion, Clea Siguret, Raphael Tackx, Lao Julie, Nadia Goué, Gildas Le Corguillé, Fabien Mareuil, Philippe Glaser, et al.

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A Galaxy-based One Health Antimicrobial Resistance Platform

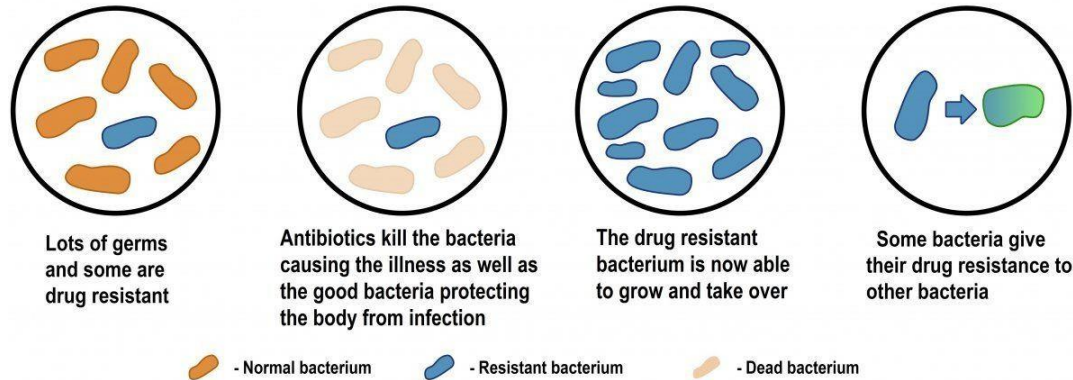
B er ence Batut on behalf of the ABRomics consortium

Galaxy Community Conference 2024

AntiMicrobial Resistance (AMR)

Bacteria, viruses, fungi and parasites no longer respond to antimicrobial medicines

How antibiotic resistance happens



One of the Top Global Public Health and Development Threats

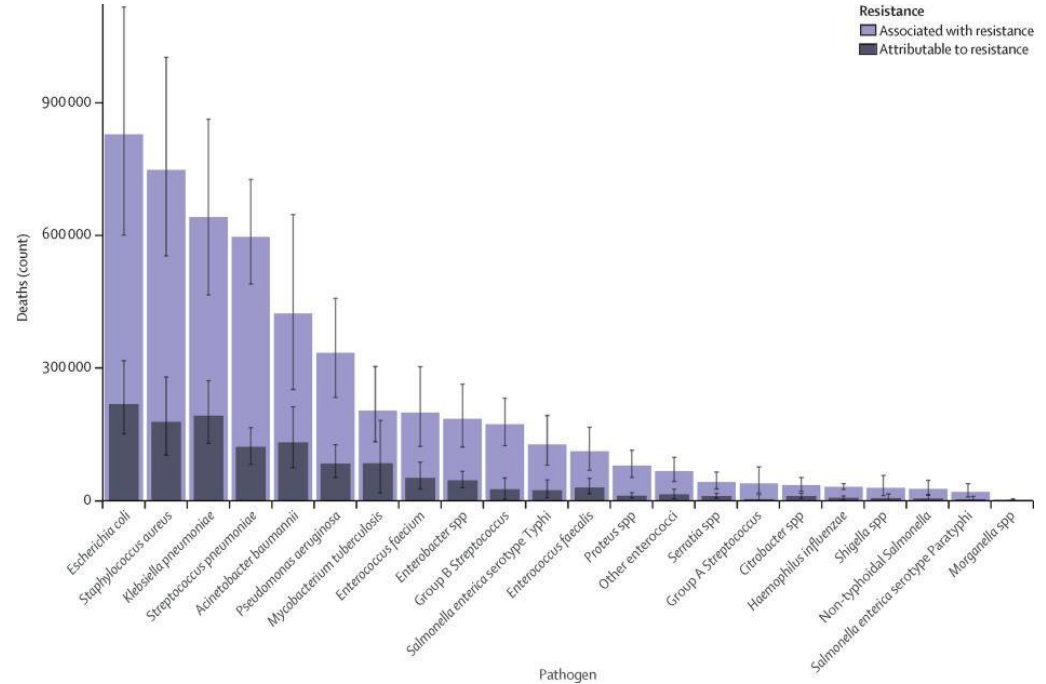


Figure 2 - Antimicrobial Resistance Collaborators et al, The Lancet, 2022.

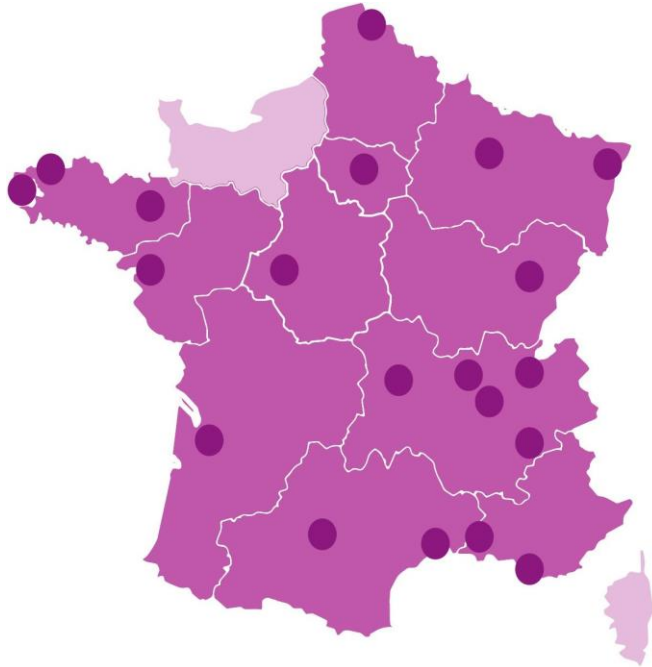
Rationale for ABRomics

1. Increasing access to **sequencing for clinical laboratories**, including outside university-teaching hospitals
2. Improvement thanks to **genomics** and **metagenomics** of our knowledge about the (complex) circulation of antibiotic-resistant bacteria, mobile genetic elements (MGE) and antibiotic resistance genes (ARG)
3. Mostly siloed investigations, while a **global picture** is needed

To address this gap in the French ecosystem:

ABRomics (2 M€ for 4 years): a multi-omics One Health platform for collaboration and data sharing between researchers and clinicians for AMR surveillance

ABRomics Consortium



National team effort

- 43 partners
- **Multidisciplinary consortium**
- **National reference centers for antibiotic resistance**

Coordination

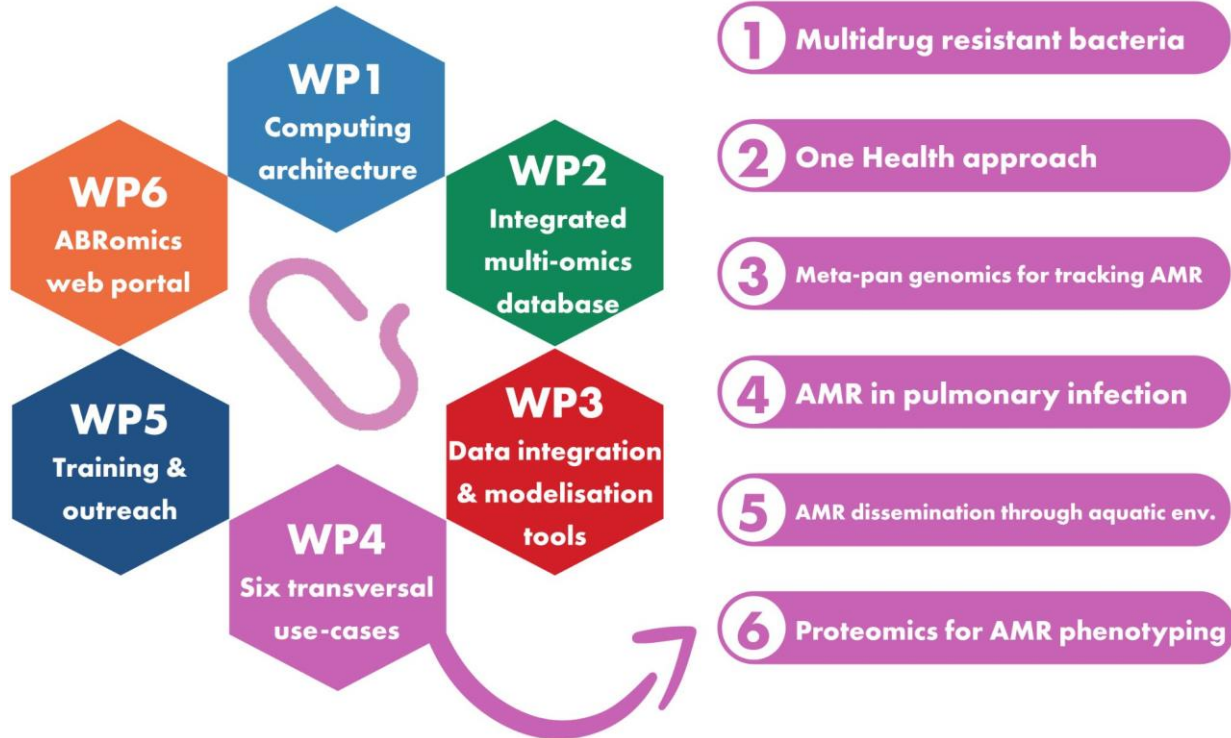
- Claudine Médigue (French Institute of Bioinformatics)
- Philippe Glaser (Institut Pasteur)

ABRomics Objectives

- Provide an open access to genomic and metagenomic analyses through **standardised and controlled pipelines** and an up-to-date set of **mathematical and bioinformatic tools**
- Build a repository of **structured, interoperable, standardized and well-annotated multi-omics microbiological data** from **human, animal and environmental origins**
- **Be easily usable** by non bio-informaticians and experts in AMR analysis
- Provide a **shared platform** to improve the **surveillance and research on antibiotic resistance across human, animal and environment sectors**

**Online One Health community-driven platform
to scale up and improve surveillance of antibiotic resistance**

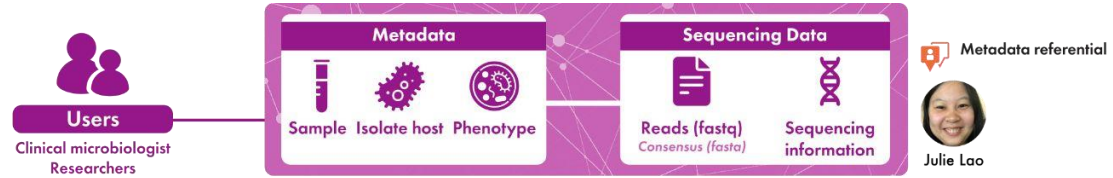
Work Packages of ABRomics



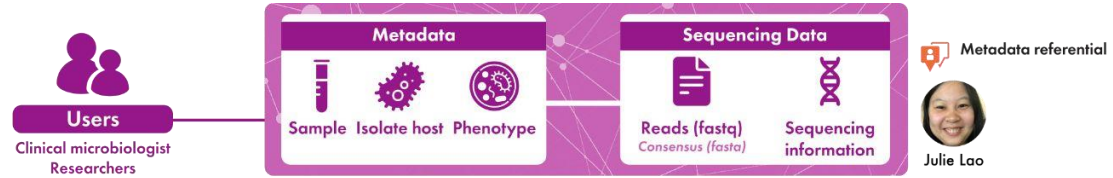
ABRomics Platform



ABRomics Platform

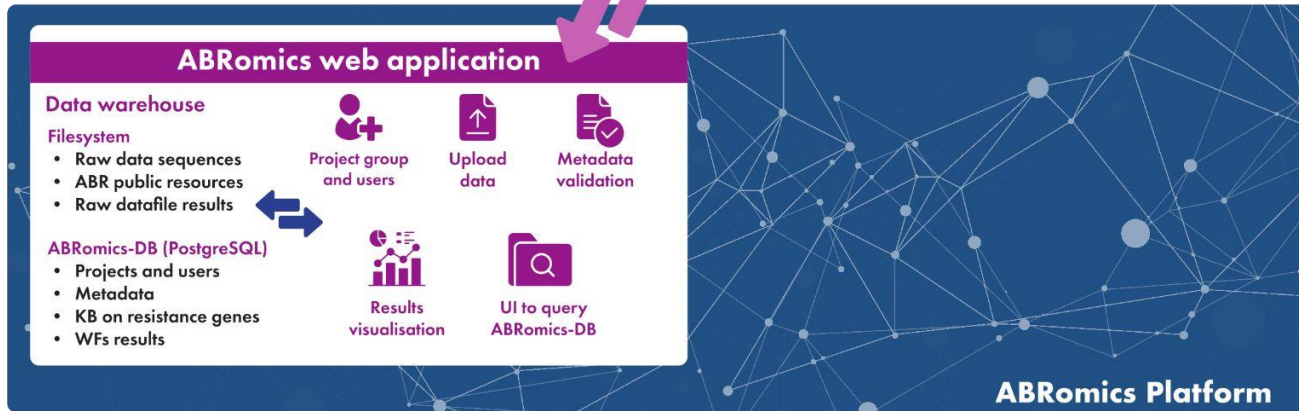


ABRomics Platform

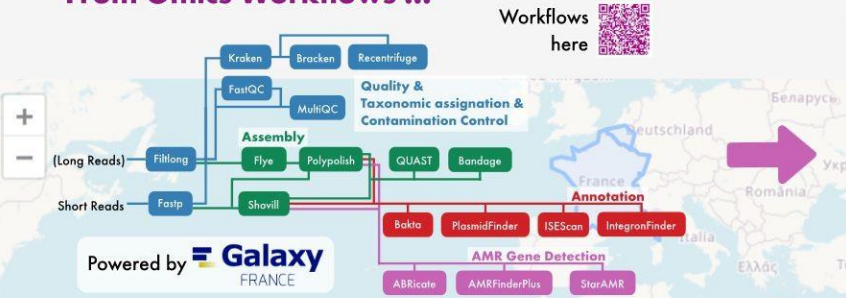


Web application interface

-  Romain Dallet
-  Raphaël Tackx
-  Amanda Dieuaide
-  Thomas Mignon
-  Fabien Mareuil
- Database structure
-  Julie Lao



From Omics Workflows ...



To Analysis reports ...

Quality metrics

Analysis summary

Genomic result report

Antimicrobial resistance analyses - Acquired resistance genes

Sample metadata summary

The ABRomics Platform features ...

1 Project management

User list of Projects

CREATE PROJECT

- Add user to project
- Modify project
- Delete project

1 Projects > Etienne test ABRomics

2 IMPORT SAMPLES **3 CREATE ANALYSIS** **DOWNLOAD CSV** **DOWNLOAD XLSX** **PUBLISH SAMPLE(S)** **DELETE SAMPLE(S)**

Sample ID	Strain ID	Instrument model	Sample type	Host species	Microorganism scientific name	Country	Place	Sampling date format	Sampling date	Sample comment	Permission	Created on	Status	Actions
C_theurid_165	CT165	Illumina MiSeq	human	Blood	Homo sapiens	France		dd/mm/yyyy	2023-12-01			maedi 12 décembre 2023 à 18:08:30		

Import Samples form

3 Run analyses

Create analysis for Citrobacter freundi

List of available analysis

- (fosta) AMR detection
- (fastq paired) Trimming, QC, Assembly, Taxonomy, Annotation, AMR detection
- (fastq paired) Trimming, QC, Assembly, Taxonomy, AMR detection
- (fastq paired) Trimming, QC

2 Upload data & metadata validation

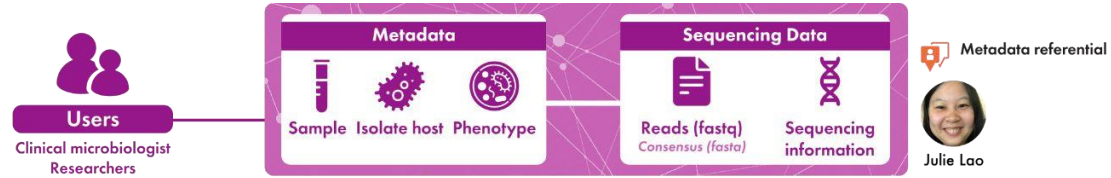
3 Run analyses

4 Results visualisation

ABRomics database samples location (map visualization)

5 Explore results of the community using the ABRomics database

ABRomics Platform



Web application interface

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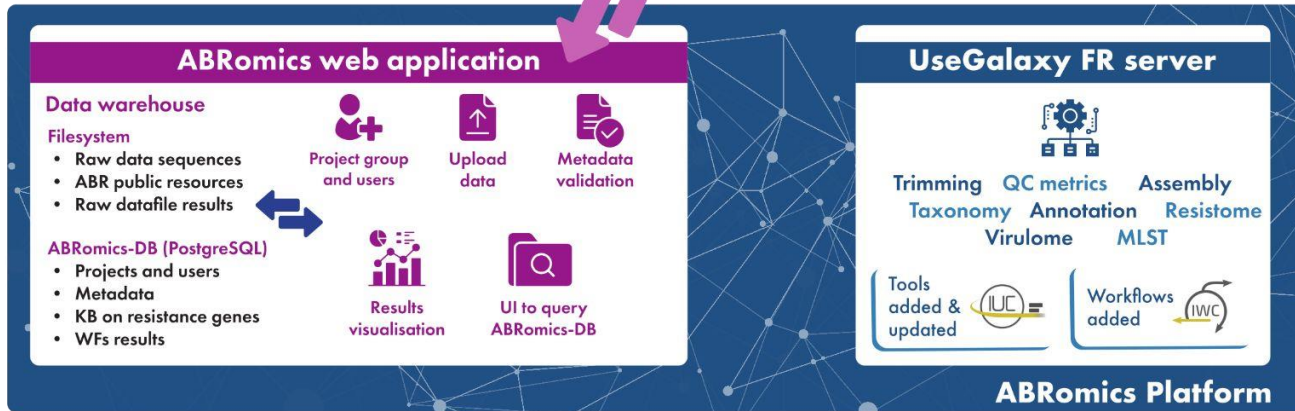
Amanda Dieuaide

Thomas Mignon

Fabien Mareuil

Database structure

Julie Lao



Galaxy workflows

Pierre Marin

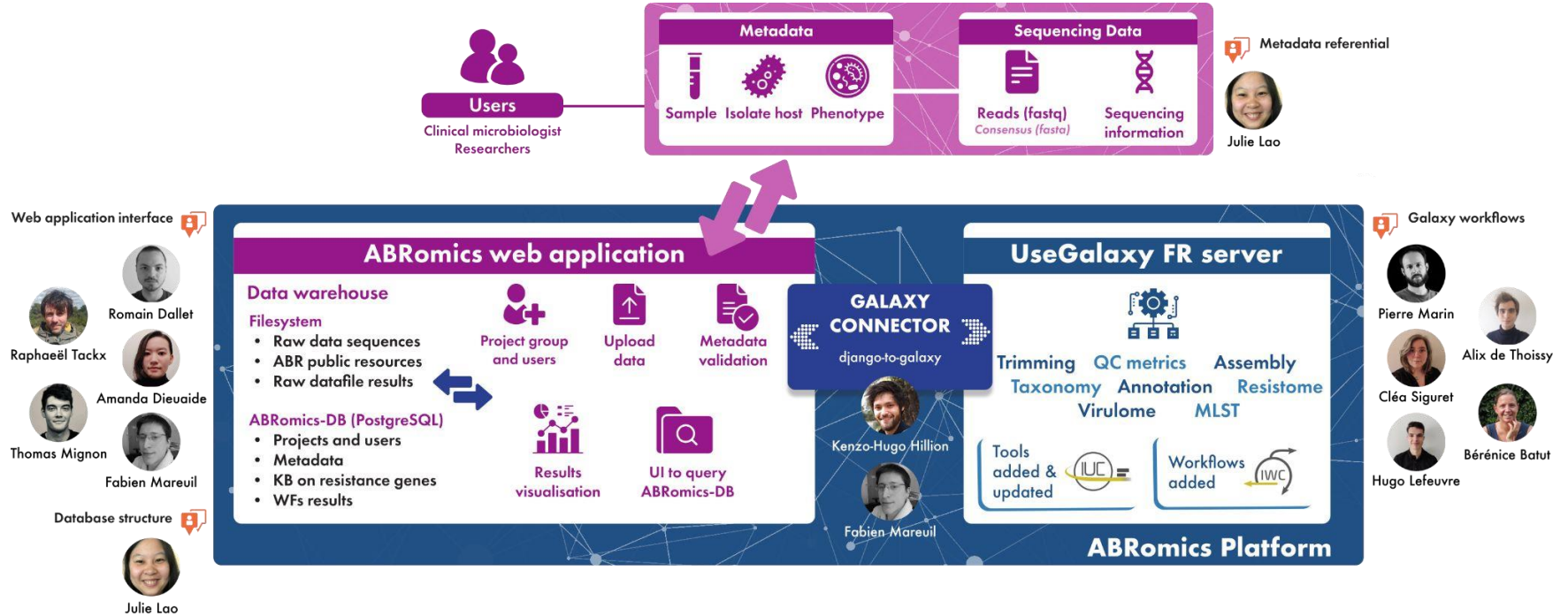
Alix de Thoissy

Cléa Siguret

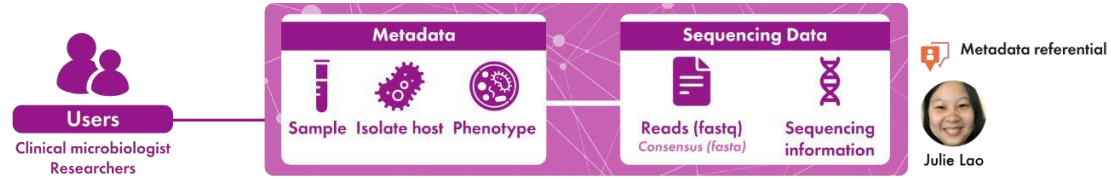
Bérénice Batut

Hugo Lefevre

ABRomics Platform



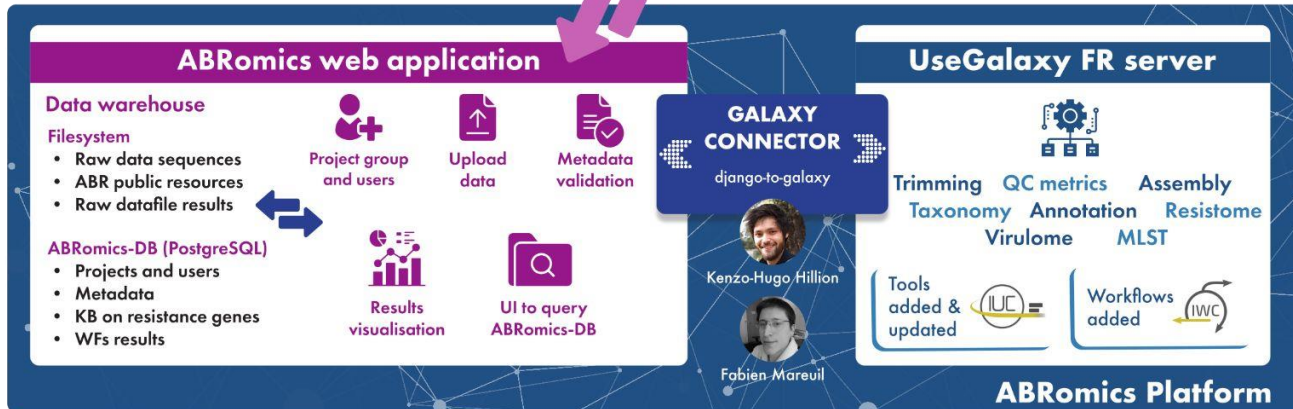
ABRomics Platform



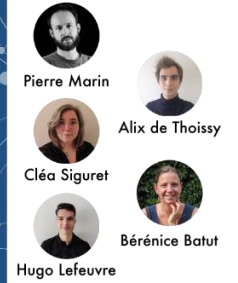
Web application interface



Database structure



Galaxy workflows

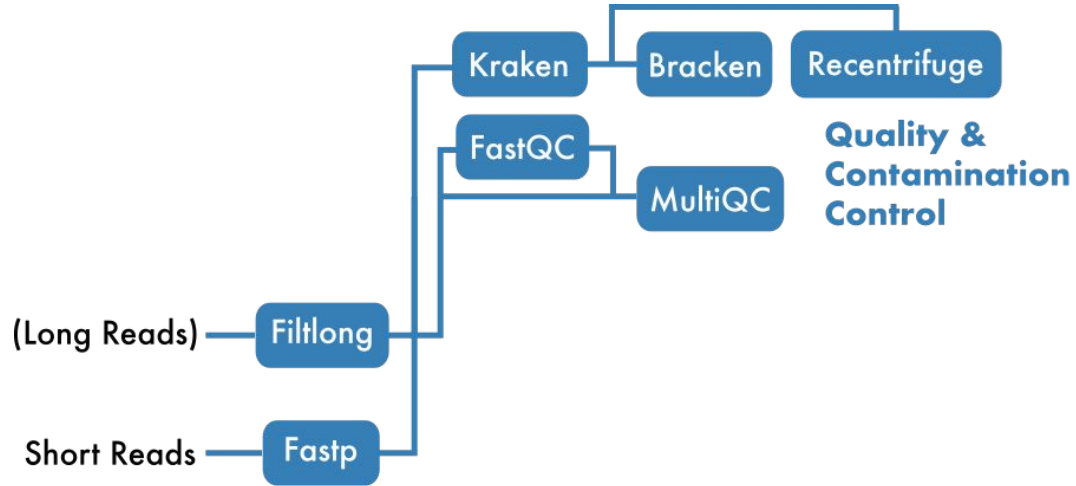


IFB core Cluster

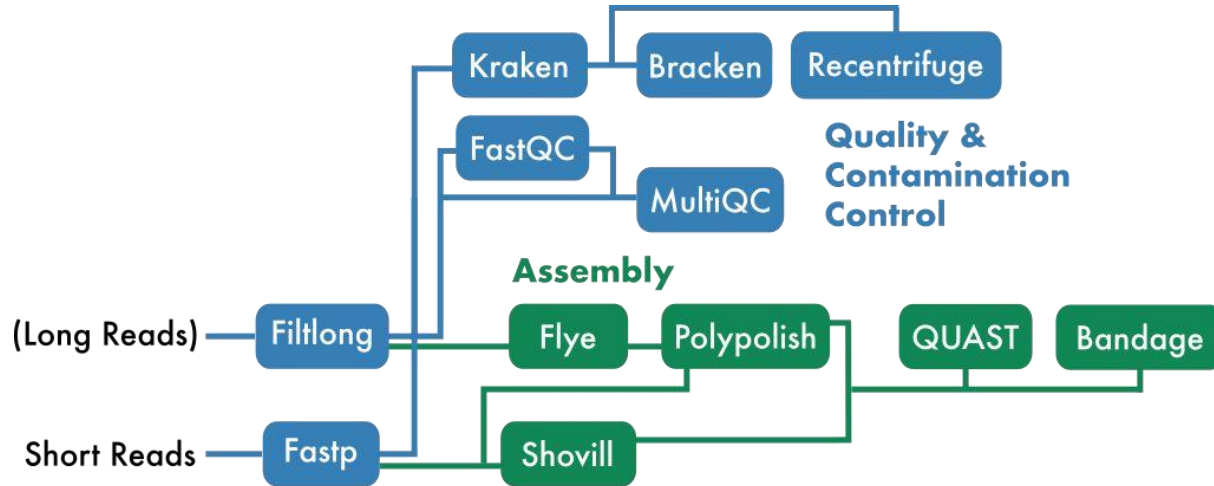


- Shared project space with right access
- Unix access to data/tools

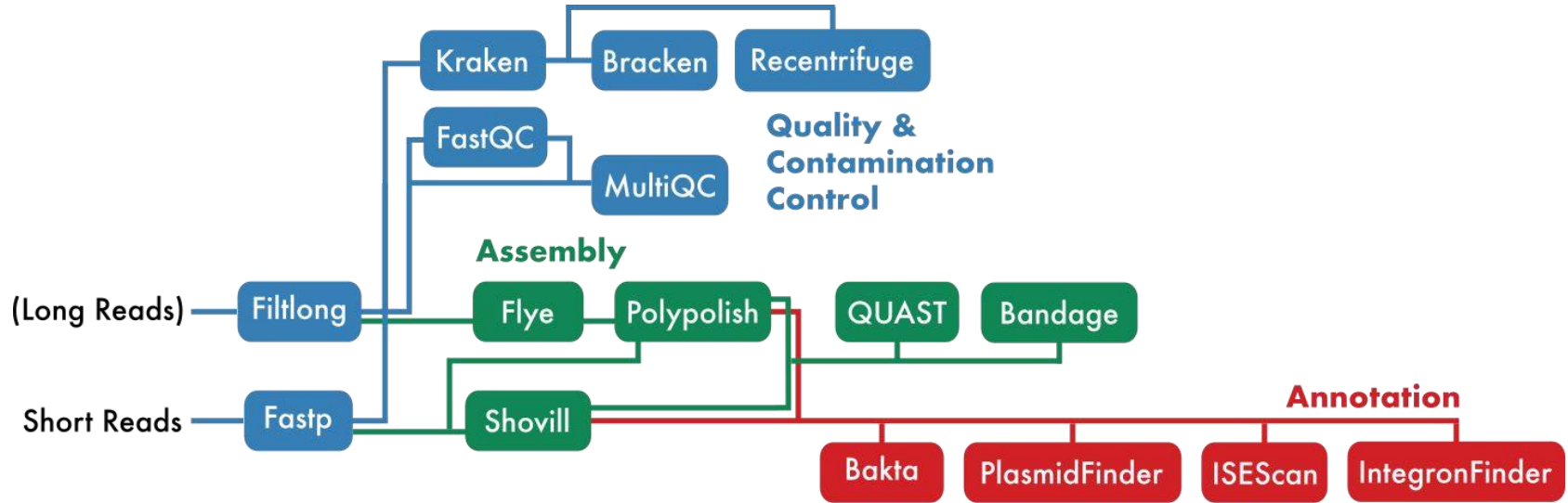
Genomics Workflows



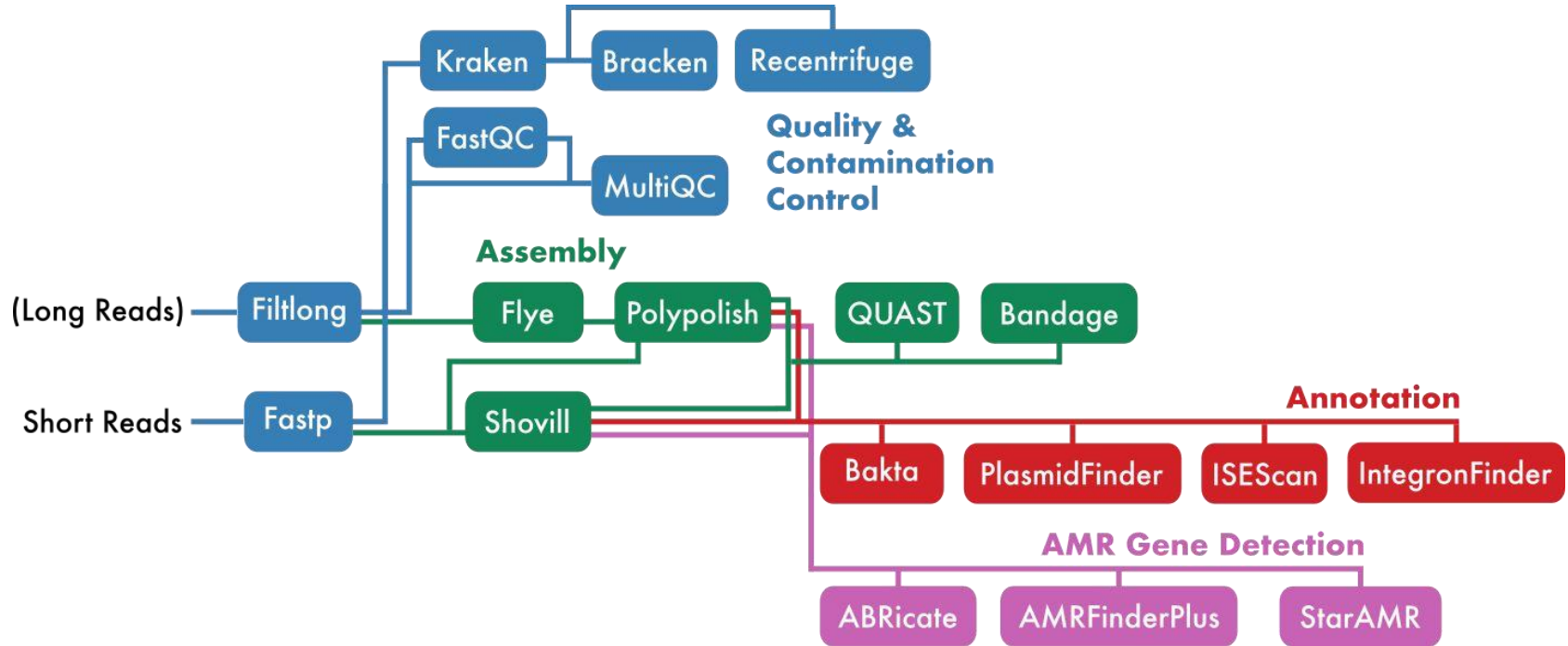
Genomics Workflows



Genomics Workflows



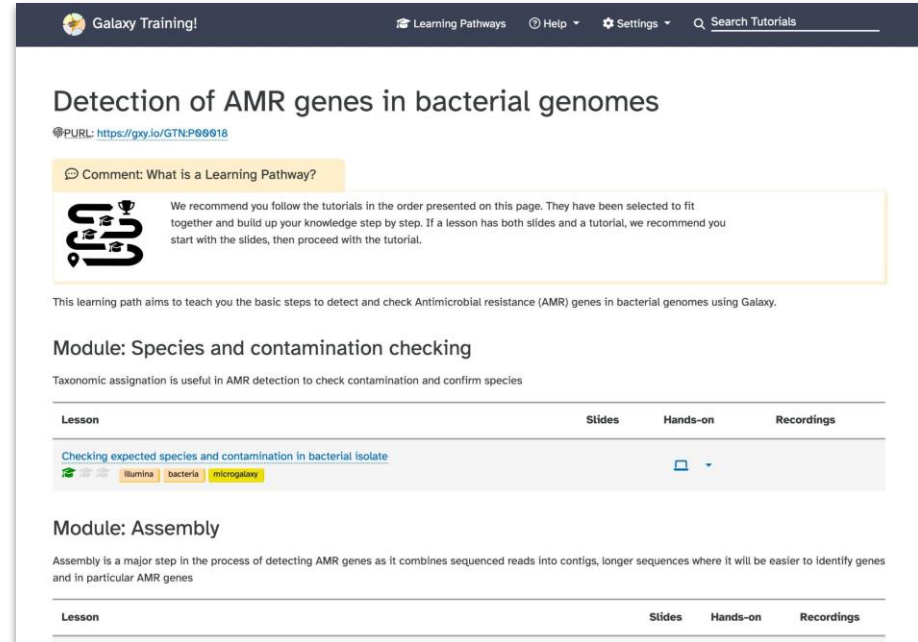
Genomics Workflows



Genomics Workflows

Subworkflows

- Available on WorkflowHub and Dockstore via IWC
- Documented as Learning Pathways on the GTN - <https://gxy.io/GTN:P00018>



The screenshot displays the Galaxy Training! interface. At the top, there is a navigation bar with 'Galaxy Training!', 'Learning Pathways', 'Help', 'Settings', and a search bar for 'Search Tutorials'. The main content area is titled 'Detection of AMR genes in bacterial genomes' with a PURL: <https://gxy.io/GTN:P00018>. Below the title is a comment box asking 'What is a Learning Pathway?' with a response explaining that the tutorials are recommended to be followed in order. A description states: 'This learning path aims to teach you the basic steps to detect and check Antimicrobial resistance (AMR) genes in bacterial genomes using Galaxy.' The interface then lists two modules: 'Species and contamination checking' and 'Assembly'. The 'Species and contamination checking' module includes a table of lessons:

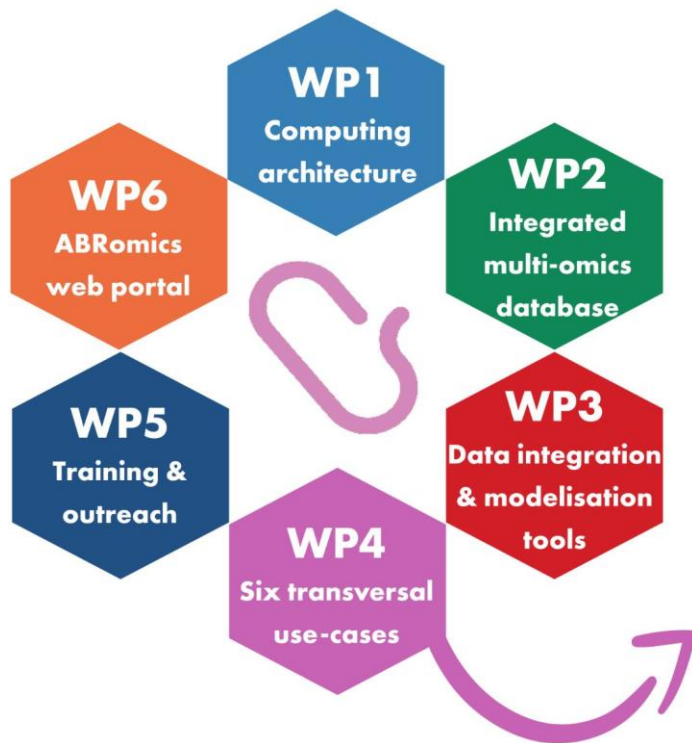
Lesson	Slides	Hands-on	Recordings
Checking expected species and contamination in bacterial isolate			

The 'Assembly' module is also listed below.

Next Steps

Workflows beyond genomics

- cgMLST
- Metagenomics
- Pangenomics
- Multi-OMICs



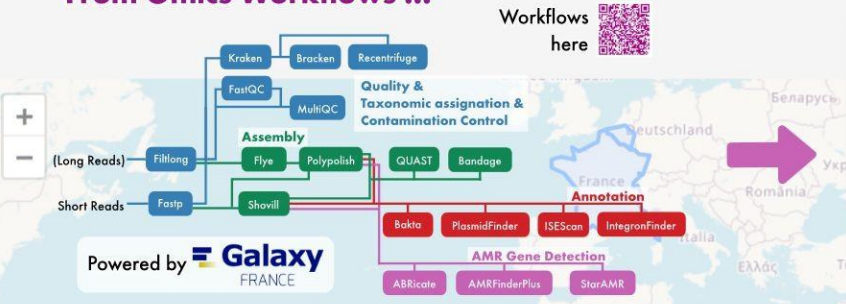
- 1** Multidrug resistant bacteria
- 2** One Health approach
- 3** Meta-pan genomics for tracking AMR
- 4** AMR in pulmonary infection
- 5** AMR dissemination through aquatic env.
- 6** Proteomics for AMR phenotyping

Thank You!



<https://www.abromics.fr/>

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ABRomics database samples location (map visualization)